GEO-HYDRO, INC
Consulting in Geology and Hydrogeology

1928 E. 14th Avenue
Denver, Colorado 80206
(303) 322-2171

Comments on the Draft Ecological Risk Assessment Prepared by Geo-Hydro Inc. on behalf of People in Need of Environmental Safety

Geo-Hydro Inc. is submitting the following comments on the Draft Ecological Risk Assessment (ERA) for the Pines Area of Investigation dated January 22, 2010, on behalf of People In Need of Environmental Safety (PINES). This ERA does not follow standard U.S. Environmental Protection Agency (USEPA) guidelines and procedures typically applied at Superfund sites. There are many risk management decisions in the document, as well as in preceding documents which influenced activities in the ERA, which invalidate the risk assessment results. Background concentrations were used early in the analysis to remove analytes from consideration. It is more typical to retain analytes until the risk characterization phase. There does not seem to be a robust statistical evaluation of background, and only four background soil samples were collected and therefore statistics cannot be performed. Decisions were made that bias risk results low, from not including mercury in the data set for all media of concern to selection of receptors that would minimize the wildlife exposure intakes. This ERA cannot be relied upon to present an unbiased estimate of ecological exposure and risk. The conclusions in this ERA should not be accepted for decision-making purposes at this site.

In addition, critical data gaps were identified during this review. Review of the data indicates that hexavalent chromium was not consistently sampled in all media; this data gap must be rectified due to the toxicity of this form of chromium and the possibility it exists in CCBs. In addition, sampling of mercury in all media, and collecting samples that represent CCBs in other places than the MWSE to fully document variability in the CCBs that could result from changes in facility operating procedures or coal source, should be performed prior to considering this site fully characterized for nature and extent. A review of the analysis and the data strongly indicate the potential for ecological risk, and action levels should be derived and a feasibility study to remove hot spots should be conducted.

Other Concerns

<u>Conservativism in the Risk Assessments</u>

At the time USEPA accepted the Remedial Investigation Report without the benefit of a functional groundwater model PINES was told that especially conservative assumptions would be used for the risk assessments. The risk assessment conservativism described by USEPA is missing from this document, rather several areas of identified uncertainty remain unaddressed that, when combined with aggressive assumptions, render the results of the ERA of questionable value.

In order for the ERA to reflect the promised conservativism it is appropriate that the risk assessments consider ALL of the available data, including historical data from the facility, non-RI data that was collected during the course of the RIFS investigations, and post-RI data that may have been collected. Such data are available in the RIFS documents, in sources cited in RI documents, and in communication provided to the USEPA over the course of the RI. Much of this data was collected under approved sampling plans and protocols as part of demonstrations to the designated regulatory authority and/or produced as the result of compliance monitoring of the Yard 520 facilities. For instance, The RIFS program did not collect of pore water leachate from the piezometers screened or partially screened in landfilled waste within the footprint of Yard 520. Regulatory-program data from the latter do exist in the historical files cited in the RI documents and should be used in RAs. [For example, boron in well MW-2 has been as high as 40 mg/L, about twice as high as any concentrations reported in the RI data. Similarly, arsenic concentrations in groundwater as measured in pre-RI regulatory-program sampling immediately north of Yard 520 has exceeded 500 ug/L episodically.] Degradation of the waste and longer contact time between waste and porewater can be expected to continue to increase concentrations of soluble contaminants in the leachate. RAs should consider and reflect these data and processes. Some were produced independently of such regulatory programs. Although variable weighting may be appropriate, conservatism dictates that data beyond that collected by the RI be considered in the ERA.

Flow Direction Uncertainty

The absence of a usable groundwater model is borderline crippling for risk assessments associated with a Superfund groundwater plume. The data show that the Yard 520 landfill has not yet come into hydraulic or chemical equilibrium with its surrounding environment. Leachate heads were observed to be rising during the time that field sampling for the RI was being conducted. It remains unknown whether the increasing leachate head within the landfill is continuing or has since stabilized. The impact of rising landfill leachate head on future groundwater flow rate and direction has never been evaluated and may result in underestimation of areas that will eventually be impacted by migration of contaminants with groundwater.

The best-available back-up is consideration of existing head data and using the topographically-driven conceptual flow model. Under such considerations, leachate from Yard 520 will discharge directly to Brown Ditch when adjacent to it, migrate north-northeastward across the neighborhood to Brown Ditch as it migrates across the dune line, and migrate north-northwestward for discharge into the Great Marsh of the National Seashore. Further, based upon surface flows, reflecting the topo-driven conceptual model, the leachate migrating into the Great Marsh from Yard 520 will migrate into areas of the headwaters of tributaries feeding both Brown ditch (flowing NE through the Great Marsh and Derby Ditch flowing SW through the Great Marsh and feeding particularly critical and sensitive habitats. The ERA should reflect the complexity of these patterns and address receptors in all flow directions. Flow directions from other disposal areas need to be similarly evaluated based upon the limited existing head data and a topographically constrained conceptual flow model.

Because of the uncertainty associated with future flow directions and rates the ERA should not be restricted to the current distribution of receptors. This was partially reflected in the USEPA's early admonition to the PRPs that a "write-off" of the shallow aquifer since current citizens are now on municipal water is not acceptable. The same applies to other routes of exposure. No exposure scenario can be ignored or dismissed.

Contaminant Concentration Uncertainty

The RIFS program did not collect of pore water leachate from the piezometers within the landfilled waste within the footprint of Yard 520. Regulatory-program data from the latter does exist in the historical files cited in the RI documents and should be used in RAs. For example, boron in this well has been as high as 40 mg/L, about twice as high as any concentrations reported in the RI data. Similarly, arsenic concentrations in groundwater as measured in pre-RI regulatory-program sampling immediately north of Yard 520 has exceeded 500 ug/L episodically; the ERA should consider and reflect these data. Source concentrations from other disposal areas need to be similarly evaluated based upon ALL available data where actual source concentrations were not measured.

Concentrations of contaminants that exist in groundwater today must be assessed for ALL hydrochemical processes that may affect them in the future. The evaluation logically includes hydrochemical processes that attenuate the concentrations. It must also logically include hydrochemical processes that can increase their concentrations. Unlike organic contaminants that can be consumed or destroyed, inorganic contaminants are perpetual. Attenuation processes are best viewed as reversible processes that temporarily store the contaminants or slow their migration. Thus, what is observed today is not properly considered the worst-case or the only case that needs assessment. Reasonable future changes to the hydrochemical system need be considered and the results of those changes assessed.

Arsenic (and other contaminants) attenuation from groundwater is directly offset by increased concentration in the attenuating soils. This was previously raised with respect to arsenic in the course of the RI and USEPA directed PRPs to look for such zones of concentration in soils. The PRPs looked in areas unlikely, or not possibly, in the path(s) of migration and found no samples with sequestered arsenic. It is KNOWN that the arsenic is being attenuated under today's hydrochemical system. The PRPs identified areas where the attenuation is NOT occurring, but not where it is occurring. In the absence of measurements of soil concentrations in the attenuation paths, an alternative method of assessment of exposure to such soils needs be performed. Since arsenic sequestration by adoption can reach concentrations of percentages in iron-rich sediments, this is not a trivial issue. Future subtle changes in water quality in the migration path can remobilize sequestered arsenic, from a soil that has orders of magnitude higher concentrations than the original CCW.

A related mechanism for exposure is the potential impacts of a leachate plume that mobilizes contaminants otherwise sequestered from in situ native soils. Again, using arsenic as an example, natural concentrations of arsenic adsorbed onto iron-rich sediments can be quite high. Introducing a leachate plume with different pH and/or Eh or with a dissolved species that competes with arsenic for adsorption sites can result in mobilization of arsenic at levels of environmental, health, and/or regulatory concern - whether or not arsenic is migrating with the original plume.

An assessment of the waste composition and existing leachate quality should be made to identify currently non-mobile contaminants that may become mobile as the hydrochemical environment evolves with time. For example, although selenium is not currently observed in ground or surface water at levels of concern, it is known and readily demonstrable that selenium is not particularly mobile over much of the range of hydrochemistry that arsenic (currently of concern) is mobile. However, as CCW wastes weather and key water quality parameters evolve (especially pH and Eh), arsenic may lose mobility and Selenium may become mobile, creating different risks to different receptors.

The expected migration of the CCW plume into and through the Great Marsh toward diverging stream headwaters presents another method for increasing concentrations. It is well established that water losses to evaporation and transpiration in wetland areas can increase concentrations of constituents in passing groundwater, processes collectively shortened to evapoconcentration. The same processes will increase concentrations of CCW-derived contaminants, other than those selectively taken up by wetland vegetation. Thus, concentrations in a plume entering the Great Marsh cannot be considered the concentrations that will exist as the plume migrates through the Great Marsh and discharges to surface water bodies. Since the plume concentration may be expected to continually increase along that migration interval, ecological effects must be evaluated relative to the increased concentrations and any impacts upon discharge to stream headwaters must be assessed for the enhanced plume composition, not the composition as the plume enters the Great Marsh. Using the influent concentrations will underestimate the impacts in such a hydrologic setting.

Specific Comments

1. Executive Summary, ES-1, 2nd paragraph. The text states that care is taken to focus the ERA on only those constituents above background. This is not consistent with current guidance and standard practice. The standard practice is to carry all constituents that exceed screening levels through the risk assessment, and then evaluate them in the uncertainty analysis relative to background, removing them as contaminants of concern (COCs) for the risk management documents (i.e., the feasibility study (FS), record of decision (ROD), or corrective measures study (CMS)) only if they fall within the background range. This approach should be revised to evaluate potential risks to all contaminants of potential ecological concern (COPECs) that exceed screening levels.

2. Executive Summary, ES-4, 1st paragraph. The text states that only coal combustion byproducts (CCB)-related constituents were considered as COPECs, and that the essential nutrients were removed. Please provide a table summarizing the CCB-related constituents and their percentage composition herein. If the nutrients are found in CCBs, they should only be removed after comparison to either screening levels or the range of typical nutritional requirements. Obviously, excess salts in a freshwater ecosystem are potentially problematic.

3. Page 1-2. 1st paragraph. The field notes (Appendix B) of the qualified ecologist should be referred to here. If observation is being relied upon to reduce uncertainty and serve as an additional line of evidence, then the data from transects, population surveys, etc. should be summarized and provided.

4. Page 3-7. Section 3.2.4.1. Given that the IDNL is recognized as a significant ecological resource, and that previous habitat descriptions indicated that there was good quality, undisturbed habitat in the study area (2nd and 3rd bullets), the statement that there are no unique habitats (Page 3-6) is premature. Undisturbed habitat of good quality in an area of disturbance is unique or at the very least, important. In fact, there may be numerous special status plant and animal species in the study area. The following section (3.2.4.2) confirms this.

5. Page 3-8, last full paragraph. Risk management statements such as “the areas potentially impacted by CCBs in groundwater are limited” should be removed. The risk assessment is the place that this is determined, and since the risk characterization is to follow, this statement is unsupported conjecture. It remains unknown whether the increasing leachate head within the landfill is continuing or has since stabilized. The impact of rising landfill leachate head on future

groundwater flow rate and direction has never been evaluated and may result in underestimation of areas that will eventually be impacted by migration of contaminants with groundwater.

6. Page 3-9. Section 3.3.3. The text states that exposure was considered where CCBs were placed, but that areas where CCBs were placed aren't representative of ecological habitat. This statement is erroneous. Many ecological receptors utilize the areas next to roadways or railroad tracks as habitat. Deer and other herbivores are often observed grazing along roads, and may come out to lick salt from roadways in the winter. Raptors and carnivorous mammals will utilize road kills opportunistically, and therefore be exposed to soils next to roadways. Biasing sample locations to avoid CCB locations, or not including certain sampling locations along roads, is a risk management decision that would bias the results of the risk assessment low. Areas where CCBs were placed must be retained in the risk assessment. If no or minimal risk is predicted in the risk characterization, or if data showing the nature and extent indicate that the overall extent is spatially limited relative to native soils, then it becomes a nonissue. The way the text reads at this point indicates that CCB contamination was in fact not evaluated in the report, which if so, defeats the purpose because the ecological risk assessment (ERA) cannot be used as a decision-making tool. If samples of CCBs were used, it should be stated here, and the text corrected for clarity and accuracy.

7. Table 3-3. It would appear that there were only two surface water sampling locations used in the ERA to represent the pond ecosystems, although they were sampled multiple times. This is not adequate by which to establish potential variability in different pond systems and the resulting risk to aquatic life or wildlife drinking from surface water.

8. Table 3-6 and Figure 3-7. Sample SW-003 is listed as an upgradient sediment sample. However, drinking water wells in this area were found to contain elevated concentrations of in boron and molybdenum (RI Figures 1-6 and 1-7). If groundwater discharges to the stream at this location, this sampling point cannot be considered representative of ambient conditions. The source of boron and molybdenum concentrations at this location should be determined. It should be verified that groundwater is recharging, not discharging, in this vicinity. Else, this sample and its duplicate should be considered with the other impacted samples.

9. Table 3-7 and Figure 3-8. Numerous surface water samples are listed as "upgradient". See above comment regarding sample SW003. Also, considering the proximity of many sampling locations to potential sources (i.e., highways, roads, and utility trenches), the concept of upgradient is misleading. They may be upgradient from the site, but not upgradient from potential CCBs disposed of outside the site boundaries. Figure 2-3 shows that SW017 is adjacent to visually identified CCBs. Therefore, it cannot be used to establish "background" or naturally occurring ambient conditions.

10. Figure 3-2. Ecological habitat in the southern portion of the area of investigation is missing from this figure.

11. Page 3-10. 4th bullet. It is incorrect to state that the depth of the CCBs is deeper than most ecological receptors would be expected to go to. Certain ecological receptors are potentially exposed to deep soils. The overall effect of not analyzing soils to depth that CCBs occur at is to underestimate ecological risks. Plant roots will access deep soils (depending on species). Burrowing mammals, invertebrates, and amphibians will dig to below 1 m. For example:

M.J. McMahon and A.D. Christy. 2000. Root Growth, Calcite Precipitation, and Gas and Water Movement in Fractures and Macropores: A Review with Field Observations. Ohio J Sci., 100 (3/4):88-93, 2000

12. Page 3-11. The ERA evaluates a reduced list of COPECs based on previous work performed in the Yard 520 report and RI report. The Yard 520 and RI reports were not the appropriate document for this risk management activity because they did not take into account the full considerations of an ERA. The ERA should evaluate all data available for the entire suite of target analytes. The overall effect of not analyzing all COPCs that are site-related is to underestimate ecological risks.

13. Page 3-14, Section 3.7, 2nd paragraph. The nutrients should have been evaluated against maximum daily intakes required for nutritional purposes and background prior to dropping from the analysis. The presence of high sodium and other salt concentrations is detrimental to freshwater wetland and aquatic systems. For example, freshwater is typically defined as containing <5 ppm salts. Adding additional salts, altering the hardness or alkalinity or pH, of a receiving stream can affect the native aquatic community. This should be evaluated in the ERA and not summarily disregarded as a nonissue.

14. Page 3-14, Section 3.7.1. The first of the sources in the sediment benchmarks hierarchy are the Region 5 ESLs, if nothing is available, the ERA defaults to the next listed source in the hierarchy. However, the logic behind the derivation of the hierarchy is not clear. There are numerous sources of sediment quality criteria, each of which may have slightly different interpretations. Often conservative assumptions are made, such as to use the lowest value of all the sources. For this ERA, a preferential hierarchy was applied that infers that the “best”, least uncertain, or most appropriate sediment sources are applied first. However, justification for this hierarchy should be provided. A different result could be obtained by applying a different set of rules for this hierarchy. It would be preferable to select the lowest value from the preferred sources for the initial screening exercise due to the variability in the sediment benchmarks, the uncertainty as to which are the most applicable, and the lack of field collected biometrics or sediment toxicity tests. The results of the screening level analysis are biased low by the hierarchal approach, as many of the other screening values are lower. The various values are summarized in Attachment A. Additional questions/comments follow:

    a. Persaud, 1996. Is this actually the Persaud 1993 report? It is not clear why Persaud was selected as the second tier in the hierarchy when there are other more recent sources. For example, if MacDonald et al. (1999) had been used prior to the LEL in the hierarchy, the ecological screening values (ESV) for arsenic would have decreased to a value of 3 mg/kg from 9.79 mg/kg. The approach used biases the risk results low for some target analytes. More recent sources of sediment toxicity values include:

        i. Ingersoll, C.G., D.D. MacDonald, N. Wang, J.L. Crane, L. J. Field, P.S. Haverland, N.E. Kemble, R.A. Lindskoog, C. Severn, and D.E. Smorong. 2000. Prediction of Sediment Toxicity Using Consensus-Based Freshwater Sediment Quality Guidelines. EPA 905/R-00/007 June 2000.

        ii. J.L. Crane and S. Hennes. 2007. Guidance For The Use And Application Of Sediment Quality Targets For The Protection Of Sediment-Dwelling Organisms In Minnesota. Minnesota Pollution Control Agency, St. Paul, MN. February 2007. MPCA refers to their guidelines as the Sediment Quality Targets (SQT). The guidance has two levels that bracket the acceptable range of sediment concentrations. The Level I SQTs identify contaminant concentrations below which harmful effects on sediment-dwelling organisms (i.e., benthic invertebrates) are unlikely, whereas the Level II SQTs identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are likely. Note that for metals, Crane and Hennes (2007) cite MacDonald et al. (2000).

iii. D. D. MacDonald, C. G. Ingersoll, and T. A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39, 20–31 (2000).

iv. MacDonald, D.D. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Technical Report. Florida Department of Environmental Protection. January 2003.

b. Background values from NOAA are used for aluminum (Al), strontium (Sr), and vanadium (V). This is not appropriate for a risk assessment. The approach is not risk-based, and the NOAA background may have nothing to do with site conditions. Where a screening value (SV) is unavailable, the analyte must be carried through the risk assessment and addressed by another approach: Sediment toxicity bioassays, measurement of benthic invertebrate populations and application of biometrics, and comparison to site-specific background.

15. Comments to Sediment SVs, Table 3-9 (See Attachment A).

a. This table reports an ND for metals that were not detected. The screening value should be shown so that the adequacy of the reporting limits can be verified. If the reporting limits exceed the screening values, there is more uncertainty in the risk results.

b. Table 3-9 indicates that mercury was not sampled. This is a data gap that could lead to underestimation of the risk results. Mercury is associated with CCBs.

c. A value of 20,000 mg/kg for iron is shown and references the Region 5 ESLs. A search for iron indicated it does not appear in the Region 5 ESL table. The correct citation would be Ontario, 1993 or another source.

d. If the source (c) was used first as the hierarchy states, the value for aluminum should be the lowest of the reported values in MacDonald et al., 1999, A Compendium of Environmental Benchmarks, Appendix 3-1 (15,900 mg/kg) and not 25,500 mg/kg from source (d).

e. The source for the value for uranium is given as the USEPA EcoSSL document for aluminum. The word "uranium" did not appear in an electronic search of this USEPA document. Please correct the reference.

16. Page 3-15. The surface water screening hierarchy is given as the lower of the Indiana or Federal AWQC, which is appropriate. Additional sources are used when values from the primary sources are lacking. The average hardness in Brown Ditch was applied to the evaluation of the hardness dependent metals. This could lead to biasing the results high or low. The hardness dependent metals should be evaluated on a sample by sample basis, or with the lowest (not average) value to verify that there are no samples that exceed the AWQC.

17. Page 3-15. Please list the metals in the text for which dissolved data were compared to total recoverable criteria. The only appropriate comparison would seem to be dissolved criteria to

dissolved data, and total recoverable criteria to total recoverable data. If there are published justifications to doing otherwise, please provide them in the text with references. Comparing dissolved data to total recoverable criteria would bias the risk results low.

18. Comments to Surface Water SVs, Table 3-9 (See Attachment B)
    a. USEPA revised the approach to assessing toxicity of copper to the Biotic Ligand Model in 2007. At some locations, this would provide a higher AWQC than that based on the older hardness –dependent equation. This would be a more accurate estimate of an appropriate criterion.
    b. The table says ND for antimony, for not detected. Was this analyte sampled in surface water? It is not shown on Table 4-3. Summary statistics tables should be provided so that the data may be reviewed. This would make the report more transparent. Furthermore, because in this table no SVs are presented for analytes supposedly below detection, and there are no summary statistics tables showing the range of detected values and the range of reporting limits, there is no way to verify that reporting limits are adequate. Thus, the data adequacy for the risk assessment cannot be verified.
    c. The table says ND for cadmium. Cadmium appears in the data set and is not detected. Unfortunately, the reporting limit for dissolved cadmium (0.53 ug/L) exceeds the AWQC (0.33 ug/L) based on the lowest hardness in Brown Ditch (151 ppm). Therefore, it is unknown if cadmium presents an ecological risk at sampling locations where hardness is below the average value.
    d. The lack of mercury data is a data gap. This could bias the risk results low.
19. Page 3-16. If a soil screening value is not available from the EcoSSLs, USEPA Region 5, or ORNL sources, the analyte should be carried forward as a COPC and evaluated in a baseline risk assessment. The Dutch Intervention values should not be applied. Examination of the footnotes in Table 3-9 does not indicate which analytes had Dutch intervention values used, if any. This oversight should be corrected. If these were not used, delete the text that says they will be considered. The Dutch intervention values are inappropriate for metals because they take into consideration background concentrations, which are not site-related or based on similar geology, and they are not risk-based. They also represent concentrations expected to be hazardous to 50% of the exposed species, and therefore do not make appropriate screening values.
20. Page 3-16. It is not clear why the EcoSSLs for birds and mammals were not used for soils as well as those for plants and invertebrates. The standard practice for performing a screening-level risk assessment is to use all EcoSSLs to evaluate the potential for ecological risk, or to use the lowest of the EcoSSLs. Protecting only the base of the food web (i.e., plants and invertebrates) is not sufficient if soil concentrations are toxic to mammals and birds.
21. Page 3-16. Background should be addressed in the risk characterization stage of the ERA. All data should be compared to risk-based SVs prior to removing from the analysis because they are supposedly less than background. This is considered standard practice for human health and ecological risk assessments. If the data are compared to ESVs first prior to background, this should be more clearly stated.

22. Page 4-3. Section 4.1.3. 3rd paragraph. If the sample number was insufficient to compare to background, why is there a statement that the concentrations were "not consistent with background"? These statements occur throughout section 4, where pond samples are compared to background (or indirectly to background by comparing to Brown Ditch) although sample size was insufficient to perform the background comparison. If the data are insufficient to perform the background analysis, these statements should be removed. They belong in an uncertainty analysis.
23. Page 4-4. The sediments in Brown Ditch are evaluated for plant toxicity but not the pond sediments. The pond sediments should be addressed as well.
24. Page 4-5. Section 4.1.5. Last paragraph. Mercury is retained as a COPEC in soils although it does not appear to have been analyzed in every medium. This represents a severe data gap that will potentially bias the risk results low.
25. Page 4-5. Section 4.1.6. Last paragraph. The text states that food web COPECs were those that were retained in sediment, total recoverable metals in surface water, or suspected CCBs. COPECs in any medium should be retained for food web evaluation, because birds and mammals in the area are also potentially exposed to COPECs in soil bioaccumulating in plants and invertebrates, as well as small birds and mammals in direct soil contact. Birds and mammals are also potentially exposed to COPECs in discharging groundwater due to bioaccumulation in benthic invertebrates, fish, and wetland/riparian vegetation. The approach used in the ERA is not technically defensible and is yet another example of data manipulation that will bias the risk results low.
26. Page 4-5. Section 4.1.5. It is unclear from the text if mercury was the only COPEC retained for analysis in the foodweb. There are 22 bioaccumulative chemicals of concern (BCCs) under the Great Lakes Initiative which regulates them by a mixing zone ban. Mercury is the only metal on this list. However, this does not mean that other metals do not bioaccumulate, often to significant and toxic levels. There are linear regressions and bioaccumulation/bioconcentration factors available in the regulatory and primary literature that can be used to address modeling tissue concentrations for dietary uptake. This should be discussed and evaluated in the report. Either insert "In addition," in front of "Mercury…." if this analyte was added because of the BCC status, or include the other COPECs in foodweb analysis. Later text seems to suggest that all COPECs were carried forward into foodweb analysis.
27. Page 4-6. Section 4.2. 2nd paragraph. Mercury is the only COPEC retained for food web evaluation. It is not the only BCCs in the original target analyte list. Furthermore, the screening values do not necessarily encompass bioaccumulation. Only the soil EcoSSLs evaluate the potential for food web exposure. The SVs that are based on toxicity to plants and invertebrates do not take into consideration that plants and invertebrates may bioaccumulate certain analytes to levels hundreds or thousands of times above abiotic media concentrations and that higher trophic level species are then potentially exposed to concentrations far greater than the measured abiotic concentrations. The standard practice in ecological risk assessment is to retain any BCCs regardless of whether they exceed SVs based on lower trophic levels, and perform an analysis that takes into consideration bioaccumulation and biomagnifications. The approach used is not technically defensible and will bias the risk results low.
28. Section 4.2.1. This section lists the receptors selected for baseline evaluation for the aquatic and terrestrial food web. There appears to be a pattern of selecting a large member of each feeding

guild for analysis. The problem with this approach is that then the analysis is not protective of smaller species that may be less mobile and thus be more affected.

a. A meadow vole would be more appropriate than the muskrat as the semi-aquatic mammalian herbivore as it is found in wetland/riparian vegetation and is smaller and has a smaller home range. This species also represents the drier upland terrestrial habitat. Alternatively, the southern bog lemming (*Synaptomys cooperi*) lives in riparian habitat and would be a more representative choice than the muskrat.

b. A smaller shorebird than the green heron such as the one of the sandpiper family would be more appropriate for the avian omnivore/invertivore.

c. The raccoon was selected as the mammalian semi-aquatic omnivore. It is a fairly large omnivorous mammal, weighing up to 7.6 kg and having a home range of 806 to 2560 ha (USEPA, 1993). There are members of the rodent family, such as the white-footed mouse (*Peromyscus leucopus*), that occur in the area that are omnivores and would more adequately represent the ecosystem. The smaller animals are more likely a keystone species than a raccoon because they would provide more of a base to the food web, and if their populations were diminished it could adversely affect the populations of larger omnivores or carnivores, both avian and mammalian, that depend upon them.

d. The mink is used to represent mammalian carnivores. Many of the mustelids (i.e., mink and weasel family) that could occur onsite are smaller than the mink and are thus potentially more sensitive to some of the COPECS. The least weasel (*Mustela nivalis*) is on the list of state species of concern (IDNR, 2007) and thus should be represented by the ERA. Using the mink would not be protective of the smaller special status mustelid.

e. The Canada goose is selected as the terrestrial avian herbivore. At 3 to 9 kg (USEPA 1993), this is the largest and therefore least protective herbivorous species that could have been selected of all the aquatic or terrestrial herbivores. There are herbivorous passerine birds that would be more appropriate (i.e., redwing blackbird) (IDNR, 2002). Alternatively, a ground-dwelling upland gamebird (bobwhite quail, snipe, or woodcock) would more adequately represent the avian community.

f. The American robin is actually omnivorous and not insectivorous as they often will eat fruit if available. There are many insectivorous species in the area, such as the flycatchers. There are at least seven species of wren in Indiana, and these are insectivorous as well.

g. The smaller American kestrel or screech owl would be more appropriate as a choice of a raptor species than the much larger red-tailed hawk.

References:

Indiana Department of Natural Resources (IDNR). 2002. Birds of Indiana State Parks and Reservoirs Checklist. http://www.in.gov/dnr/files/birds2.pdf

Indiana Department of Natural Resources (IDNR). 2007. Mammals of Indiana. April 2007. http://www.in.gov/dnr/fishwild/files/Mammals_of_Indiana_April_2007.pdf

U.S. Environmental Protection Agency (EPA). 1993. Wildlife Exposure Factors Handbook. Office of Research and Development, Washington, D.C. EPA/600/R-93/187b. December 1993.

29. Page 4-9. Section 4.2.2, 1st paragraph. The text states: *Wildlife species were assumed to be potentially exposed to constituents detected in sediment, surface water or suspected CCBs*

through the incidental ingestion exposure pathway, and through the food chain ingestion exposure pathway. For some reason, groundwater and soil are not considered as potential exposure media. This is an oversight that will bias the risk results low.

30. Page 4-12. Section 4.2.3. 3rd paragraph. Mammalian TRVs are used to represent avian TRVs in the absence of data. It is generally not technically defensible to extrapolate toxicity data between the different vertebrate taxonomic classes. The uncertainty in this approach should be clearly documented because physiologically birds are very different from mammals and an uncertainty factor of 10 is not technically justified. If possible and available, LD50s for birds and mammals should be compared to see if they are similar or how they differ. If so, there is less uncertainty that the TRV would represent toxicity to birds if one assumes that the analyte would have similar chronic toxic mechanisms as acute, but this is also uncertain.

31. Page 5-11. 2nd paragraph. The text states that 11.8% of the 255 acres of terrestrial habitat contain suspected CCBs. Additional areas may contain or be impacted by metals or inorganics from nearby CCBs that have migrated as fugitive dust, leaching to groundwater, or overland flow. The entire area was not surveyed, there appears to be no data correlating visual estimates of CCBs with metal concentrations in the surrounding abiotic media or accuracy in identifying CCBs, and there are limited records of past disposal practices, and so this is an uncertain estimate.

32. Page 5-11. 3nd paragraph. The estimates of the impacted area are not technically justified. There are numerous other ponds in the area that were not sampled and may be impacted by CCBs used for construction, road, or railroad fill. The entire site should be considered potentially impacted in the absence of adequate characterization data.

33. Page 5-11. Section 5.4.2. 1st paragraph. Throughout the report the ESVs are referred to as conservative criteria or benchmarks. If the Dutch Intervention values are used as ESVs, this is not a true statement. If background is used as an ESV, it is not a true statement because the evaluation against background is not risk-based. Either conservative risk-based ESVs should be used, or this erroneous statement should be deleted throughout the report.

34. Section 5.4. The uncertainty analysis is consistent in focusing on only those aspects of the analysis that may bias risk results high, and ignores the variables that bias results low. The uncertainty analysis should treat all aspects of the risk assessment scientifically and fairly. For example:

    a. Section 5.4.1. The text states that the site was adequately characterized. However, there are metals and inorganics associated with CCBs that were not analyzed in all media (e.g., mercury, uranium, chromium VI, radionuclides), the number of samples was limited to numbers that would not provide an estimate of variability for some media (e.g., ponds), and there is no way to determine from the RI sampling design if the site was in fact adequately characterized. Statements regarding the data adequacy should be edited to reflect the uncertainty in this ERA, or justified.

    b. Page 5-10. Last paragraph. While the first sentence acknowledges that that samples may under or overestimate the true exposure, all of the following examples only demonstrate the overestimates, again biasing the presentation of uncertainty. For example, because only one sample was collected in the deepest part of the ponds, it is unknown if the shallow areas are in fact lower in metal concentrations. If there are deposits of CCBs in the shallow but not deep areas, the statement in the text is not true. Samples should have been collected in locations where receptors may contact them. This represents a significant data gap.

c. Page 5-11. 1st paragraph. The text states that risks to benthic receptors may be overestimated if lower contaminant concentrations are present in the shallow sediments. It is also true that risks to benthic receptors may be under-estimated if higher constituent concentrations are present in the shallow areas. Because no samples were collected, the variability between the deep and shallow sediments is unknown.

d. Page 5-11. 3rd paragraph. The text states that the aquatic exposure areas are smaller than the home range for some wildlife receptors. It is also true that the exposure area is larger than the home range or the seasonal feeding territory for some wildlife receptors.

e. Page 5-11. 5th paragraph. The upgradient activities are indicated as another source of metal or inorganic contamination. It is not clear what activities this paragraph refers to. It is uncertain that the true boundaries of the site have been adequately delineated because CCBs could have been used as fill in surrounding areas beyond the area delineated as the site. Stormwater could then carry additional CCBs into the site. Upgradient sources should be clearly identified in this paragraph, and additional sampling should be performed to quantify the input to the site. If road runoff is a significant source, the data should be evaluated to determine if concentrations decrease with distance from the nearest road. Otherwise, if the RI sampling was adequate and all sources related to CCBs have been identified, this upgradient contribution should not contribute significantly to the site uncertainty.

f. Section 5.4.2. The selection of COPECs for the screening level ecological risk assessment (SERA) started with a predetermined target analyte list. The selection of COPECs should have also considered information regarding the type of contaminants in CCBs as part of the problem formulation process and also scoping.

g. Page 5-12. 2nd paragraph. If the surface water ESVs are the AWQC, they are designed to be protective of most of the species in the aquatic ecosystem, and the most sensitive 5 percent may not be protected. The text is therefore not accurate as the most sensitive species may not be protected. The USEPA AWQC calculation procedures allow for lowering of the criteria to protect economically, recreationally, or ecologically sensitive species. This paragraph should be reworded to reflect the definitions of the ESVs. The definitions of the sediment quality benchmarks should also be verified before making statements regarding uncertainty and protectiveness.

h. Page 5-13. 4th paragraph. There are frequent references to the use of maximum analyte concentrations as being overly or most conservative in this paragraph and throughout this report. However, often the sample size is insufficient to determine inherent variability. It is unknown if additional sampling that defined variability would indicate higher or lower contaminant concentrations. Where the sample size is so limited, there is no "more realistic exposure factor" as this paragraph states.

i. Page 5-13. 5th paragraph. Statements such as "*Bioavailability in prey items is probably over-estimated because the food web models assumed that the COPECs consumed by wildlife receptors were present in a form that was 100% bioavailable; however this is unlikely*" should be supported with data from references regarding bioavailability or with site-specific data for tissue concentrations in plants and animals. Some of the CCB constituents are more bioavailable than others, so statements such as this are misleading as it appears to include all constituents. For example, studies report that certain fish species exposed to coal ash contain significantly elevated concentrations of selenium, arsenic, copper, and cadmium (Staub et al., 2004). Potential bioavailability in biological fluids ranged from 40 to 90 percent for cobalt (Co), nickel (Ni), copper (Cu), and zinc (Zn), although it was lower than 30 percent for aluminum (Al), iron (Fe), vanadium (V), and lead (Pb) (Harris and Silberman, 1988). Bioavailable metals ranged from 0 percent for vanadium (V) to 80 percent for zinc (Zn) for coal-derived ash (Twining et al., 2005). Using a bioaccumulation factor or uptake regression equation accounts for both uptake and depuration, which encompasses the concept of bioavailability?

References:

Harris W.R. and D. Silberman. 1988. Leaching of Metal Ions from Fly Ash by Canine Serum Environmental Science and Technology, Vol. 22, No. 1, pgs. 109-112.

Staub BP, Hopkins WA, Novak J, Congdon JD. 2004. Respiratory and reproductive characteristics of eastern mosquitofish (Gambusia holbrooki) inhabiting a coal ash settling basin. Arch Environ Contam Toxicol., Jan; 46(1):96-101.

Twining, J., McGlinn, P., Loi E., Smith, K. Giereacute; R. 2005. Risk ranking of bioaccessible metals from fly ash dissolved in simulated lung and gut fluids. Environ Sci Technol. 39(19):7749-7756.

35. Page 6-2. 4th paragraph. The text states that upper 95th confidence levels (UCLs) were not calculated for pond sediment and surface water due to insufficient sample size but that other summary statistics were still calculated. With only two samples, an average should not be calculated either and any summary statistics are virtually meaningless.

36. Page 6-3. Section 6.1.2. 1st paragraph. The ambient water quality criteria (AWQC) are not just "screening values" that can be set aside for additional risk characterization. It is not appropriate to use the acute screening levels for surface water because there is language in the AWQC that is legally part of the criterion as follows: *except possibly where a locally important species is very sensitive, aquatic organisms should not be affected unacceptably if the four-day average concentration of* <u>*chemical x*</u> *does not exceed the numerical value of the criterion continuous concentration (CCC) more than once every three years on the average and the one-hour average concentration does not exceed the numerical value of the criterion maximum concentration (CMC) more than once every three years on the average*. Furthermore, the AWQC are different than the ecological soil screening levels (EcoSSLs) or sediment quality benchmarks (SQBs) because they are also "standards" regulated under the Clean Water Act. Therefore, the most stringent value must be retained for evaluating surface water. If the analysis was done as stated in the text, it will not only bias the results low, but violate the Indiana water quality standards and also the USEPA Clean Water Act. Section 6.2 must also be revised.

37. Page 6-3. Section 6.1.3. The text states that the dietary and water ingestion rates are adjusted with the allometric equations to the body weight of the identified receptor and that the screening level used adult body weight to estimate ingestion rates for juvenile receptors. There is an error here, because with allometric equations (and also with metabolic rate and physiology in general), smaller animals (i.e., lower body weights) result in higher dietary ingestion rates. The screening level evaluation should have relied upon smaller receptors in order to be protective of larger animals in the community, and it should have relied upon juvenile body weights in order to be

protective of the more sensitive life stages. The receptors in the analysis need to be revised to reflect smaller members of the community. The calculations and the results will need to be revised to compensate for this error. This error will bias the risk results low.

38. Page 6-4, 1st full paragraph. By applying seasonal migration factors to the analysis for "realism", the analysis no longer becomes protective of any animals that are not migratory or that do not hibernate. A preferable approach would be to initially select, or to add at this time, receptors that are not seasonally migratory or that do not hibernate, and allow the ERA to then be protective of those that are not at the site throughout the year. For example, the white-footed mouse would occur onsite as a mammalian omnivore, would not migrate, and would not seasonally hibernate. There is likely a small bird such as the dark-eyed junco or pygmy nuthatch that remains in the area throughout the winter. The only other reasonable alternative is to retain the existing receptors with a revised exposure point concentration (EPC), but delete the exposure duration (ED) "correcting" for seasonal use. Otherwise, the ERA is not "realistic" at all because the most highly and chronically exposed receptors are not evaluated.

39. Page 6-4. Section 6.2. A preferable approach to evaluating the benthic community would have been to collect additional lines of evidence in the form of toxicity tests and field population measurements in addition to applying only probably effect levels (PELs).

40. Page 6-5. 1st paragraph. Throughout the report there are references to the fact a background comparison cannot be made with the pond samples. With only two samples, one from each of two ponds, the data are inadequate not only for background evaluation but for site characterization as well. There is no certainty that additional sampling would not produce greatly different results, and that the ponds would then exceed the Brown Ditch and background samples. Thus, statements found throughout the report regarding expectations for the ponds (e.g., page 6-6, 3rd paragraph) are unsubstantiated.

41. Page 6-5. 5th paragraph. The reporting limits should be compared to the ESVs. Currently, if not detected an ESV is not shown in the tables. Effort should have been made to obtain adequate detection limits. The fact that the impacted area had higher detection limits than upgradient suggests a site-related matrix interference, possibly from a toxic constituent(s), that is potentially being ignored in the ERA and RI.

42. Section 3 tables. Tables consisting of summary statistics for detected and nondetected analytes, including all analytes, frequency of detection, and comparison to screening levels should be provided for each medium of concern. The lowest ESL for each analyte in each medium should be used as the screening level for selecting COPCs.

43. Table 3-8. ESLs should be provided for all analytes, regardless if they were detected or not. The reporting limits should be compared to the ESLs to document that the data were adequate. Mercury and hexavalent chromium should be sampled in each medium as this represents a data gap. Why does the table say ND for silica for soil invertebrates when according to the analytical data tables in the human health risk assessment this analyte was not sampled in MWSE CCBs? What medium was it not detected in that would be compared to soil invertebrates?

44. Table 4-1. The complete target analyte list should be shown when attempting to select COPCs. All COPC tables should retain any analytes with the potential to bioaccumulate in biotic media even if they occur at concentrations below the ESLs. The lack of this biases the risk results low.

a. The maximum reporting limit for nondetected samples should be evaluated to determine that analytical methodology was sufficient to perform the ERA. The number of samples and reporting limits that exceed the ESL should be presented to identify the potential extent of contamination. If not, resampling should occur or the results evaluated in the uncertainty analysis. All analytes that exceed the ESLs should be carried forward as COPCs and compared to background in the baseline risk characterization. The approach shown here is not considered current standard practice, and biases the risk results low.

b. Table 4-1. Sediment values should be compared to the EcoSSLs for wildlife and plant receptors in order to determine potential adverse effects to these receptors. Currently, sediment screening only accounts for potential toxicity to benthic invertebrates, which may have nothing to do with toxicity to riparian receptors or plants growing in sediments. A later table (4-4) shows evaluation of sediment to EcoSSLs for plants, suggesting that there is more than one COPC list for a given media. Instead, the lowest ESL should be applied to derive a single COPC list for each medium.

45. Table 4-2. What does the (i) in the third column mean? There is no footnote (i). The complete target analyte list should be shown when attempting to select COPCs. The maximum reporting limit for nondetected samples should be evaluated to determine that analytical methodology was sufficient to perform the ERA. The number of samples and reporting limits that exceed the ESL should be presented to identify the potential extent of contamination. If not, resampling should occur or the results evaluated in the uncertainty analysis. All analytes that exceed the ESLs should be carried forward as COPCs and compared to background in the baseline risk characterization. The approach shown here is not considered current standard practice, and biases the risk results low.

46. Table 4-3. As for sediment and groundwater, the complete target analyte list should be shown when attempting to select COPCs. The maximum reporting limit for nondetected samples should be evaluated to determine that analytical methodology was sufficient to perform the ERA. The number of samples and reporting limits that exceed the ESL should be presented to identify the potential extent of contamination. If not, resampling should occur or the results evaluated in the uncertainty analysis. All analytes that exceed the ESLs should be carried forward as COPCs and compared to background in the baseline risk characterization. The approach shown here is not considered current standard practice, and biases the risk results low. A later table (4-5) shows evaluation of groundwater for plants, suggesting that there is more than one COPC list for a given media. Instead, the lowest ESL should be applied to derive a single COPC list for each medium to avoid inadvertently dropping analytes from consideration.

47. Table 4-8. Previous comments referred to receptor selection and assumptions. Regarding information on this table:

a. For all receptors justify the selection of the sediment ingestion rate. Use a value for a similar taxonomic species or one with similar feeding habits.

b. Kingfishers are typically considered to eat fish. A small wading bird such as the spotted sandpiper would be more representative of an invertivore and also have a higher sediment ingestion rate.

c. The green heron is not an omnivore but a carnivore as it does not eat plants. A more appropriate omnivore should be selected from the passerines or small waterfowl. A sediment ingestion rate for a sandpiper would be more representative than the 2% used. This biased the risk estimates low.

d. To maintain consistency, all calculations should be performed on a dry weight basis, including bioacummulation factors and dietary ingestion.

e. The herbivores should be replaced with smaller animals that would be protective of a wider range of animals in the community.

48. Table 4-10 and 4-11. A default value of 1 is not a conservative bioaccumulation factor as this presumes the organism is in steady-state equilibrium with the environment. Any inorganics that are preferentially accumulated, including nutrients, can occur at higher concentrations. To reduce uncertainty, concentrations in invertebrate, plant, and fish samples should have been analyzed.

49. Section 5. The results cannot be relied upon due to the changes required to more adequately represent risk.

50. Section 6. Additional ecological data should be collected prior to performing Section 6, where the analysis relies on the use of lowest observed adverse effect levels to eliminate risk. The additional data would include laboratory fish and invertebrate bioassays to determine if aquatic life were potentially adversely affected. Field population measurements should also be made for aquatic life as well as terrestrial plants and invertebrates over several growing seasons. Tissue analysis to reduce uncertainty in the dietary ingestion pathway would also be helpful. Evaluation of small mammal populations and tissue concentrations would also reduce uncertainty. Surveys for critical habitat and threatened and endangered species should also be conducted since loss of any individual is a violation of the Endangered Species Act.

Attachment A. Evaluation of Sediment Quality Guidelines Used in the ERA Compared to Other Sources

			Screening Value Sources Cited in ERA				Additional Sediment Benchmarks																
Screening	Benthic Life-Based Sediment Screening Value from ERA (mg/kg)		Region 5 ESL	Ontario LEL (Persaud, 1993)	Compendium (MacDonald et al., 1999)	NOAA Background	ARCS TEL	NOAA ERL	NOAA ERM	NOAA TEL	OSWER Ecotox Thresholds	TECs MacDonald et al, 2000	PECs FW [Ingersoll et al. (2000)]	MN Level I	MN Level II	Florida TECs MacDonald et al, 2003	Florida PECs (MacDonald et al, 2003)	Florida TEL	Florida PEL	USEPA Region 4	USEPA Region 5	USEPA Region 6	USEPA Region 3
ALUMINUM	25,500	(d)	NV	NV	**15900**	2600	26	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
ANTIMONY	ND		NV	NV	**2**	0.16	NV	2	25	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	12	NV	NV	2
ARSENIC	9.79	(a)	**9.79**	6	3	1.1	10.8	8.2	70	5.9	8.2	9.79	33	9.8	33	9.8	33	7.24	41.6	7.24	9.79	8.2	9.8
BARIUM	20	(c)	NV	NV	**20**	0.7	NV	NV	NV	NV	NV	NV	NV	NV	NV	20	60	NV	NV	NV	NV	NV	NV
BERYLLIUM	ND		**NV**	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
BORON	NV		**NV**	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
CADMIUM	ND		**0.99**	0.6	0.2	0.1 - 0.3	0.583	1.2	9.6	0.596	1.2	0.99	4.98	0.99	5	1	5	0.676	4.21	1	0.99	0.596	0.99
CALCIUM	EN		NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
CHROMIUM III	NS?		NV	NV	6.25	7 - 13	36.3	NV	NV	NC	NV	NV	NV	43	110	43	110	NV	NV	NV	NV	NV	NV
CHROMIUM VI	ND		NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Chromium, Total	43.4	(a,f)	**43.4**	26	26	NC	NC	81	370	37.3	81	43.4	111	NC	NC	NC	NC	52.3	160	52.3	43.4	37.3	43.4
COBALT	ND		**50**	NV	50	10	28.012	NV	NV	35.7	NV	NV	NV	32	150	50	NV	NV	NV	NV	50	NV	50
COPPER	31.6	(a)	**31.6**	16	8.4	10 - 25	NV	34	270	NV	34	31.6	149	NV	NV	32	150	18.7	108	18.7	31.6	35.7	31.6
IRON	20,000	(a)	NV	20000	**8000**	18000	188400	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	20000	20000
LEAD	35.8	(a)	**35.8**	31	23	4 - 17	37	46.7	218	35	47	35.8	128	36	130	36	130	30.2	112	30.2	35.8	35	35.8
MAGNESIUM	EN		NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
MANGANESE	460	(b)	NV	460	**300**	400	630	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	460	460
Total MERCURY	NS		**0.174**	0.2	0.05	4 - 51	NV	0.15	0.71	NV	0.15	NV	NV	NV	NV	0.18	1.1	0.13	0.696	0.13	0.174	0.174	0.18
Methyl Mercury	NS		**0.00001**	NV	NV	NV	NV	NV	NV	0.174	NV	0.18	1.06	0.18	1.1	NV	NV	NV	NV	NV	0.00001	NV	NV
MOLYBDENUM	NV		**NV**	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
NICKEL	22.7	(a)	**22.7**	16	5	9.9	19.5	20.9	51.6	18	21	22.7	48.6	23	49	23	49	15.9	42.8	15.9	22.7	18	22.7
POTASSIUM	EN		NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
SELENIUM	0.95	(c)	NV	NV	**0.95**	0.29	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	2
SILICA	ND		**NV**	NV	NV	NV	NV	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
SILICON	NV		**NV**	NV	NV	NV	NV	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
SODIUM	EN		NV	NV	NV	NV	NV	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Strontium, Stable	49	(d)	**NV**	NV	NV	49	NV	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Sulfide			NV	NV	**120**	NC	NC	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Sulfides			NV	NV	**120**	NC	NC	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	130
Thallium (Soluble Salts)	ND		**NV**	NV	NV	NV	NV	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Uranium (Soluble Salts)	5	(o)	**NV**	NV	NV	NV	NV	NV	NV	NC	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Vanadium, Metallic	50	(d)	**NV**	NV	NV	50	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Zinc (Metallic)	121	(a)	**121**	120	50	7- 38	98	150	410	123.1	150	121	459	120	460	120	460	124	271	124	121	123	121

All values are in mg/kg

Definitions from ERA:

EN - Essential Nutrient.

NA - Not Applicable.

ND - Not Detected.

NS - Not Sampled.

NV - No Value Available.

Definitions from Comments:

NC - Not checked

Red values -Corrections/changes necessary per comments; see text.

Gray fill/Bold text - Appropriate value/source based on hierarchy; recommend using lowest of available screening values and not the hierarchal approach

Note that lower screening values appeared in the literature reviewed which should be considered for use in the ERA

TEL - Threshold effects level

ERL - Effects range low

TEC - Threshold effects concentration

PEC - Probable effects concentration

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archves of Environmental Contamination and Toxicology 39:20-31.

ARCS Threshold Effects Concentration Screening Benchmark - Ingersoll et al., 1996. Hyallela azteca 28 d test, total extraction, TEL value.Ingersoll, CG, MacDonald, DD, RS Carr, FD Calder, ER Long. 1996. Development andEvaluation of Sediment Quality Guidelines for Florida Coastal Waters. Ecotoxicology 5:253-278.

NOAA TEL Freshwater Sediment. SQUIRT. http://response.restoration.noaa.gov/cpr/sediment/sediment.html

Freshwater sediment benchmarks from USEPA R4, R5, R6, and R3; Florida TEL and PEL, OSWER, NOAA, ORNL cited in DOE 2011. Risk Assessment Information System, Ecological Benchmark Tool. http://rais.ornl.gov/tools/eco_search.php

MacDonald, D.D., C.G. Ingersoll, D.E. Smorong, R.A. Lindskoog, G. Sloane and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection. January, 2003.

Mn Level I And Ii, Guidance For The Use And Application Of Sediment Quality Targets For The Protection Of Sediment-Dwelling Organisms In Minnesota. February 2007.

Attachment B. Evaluation of Surface Water Quality Guidelines Used in the ERA Compared to Other Sources

Analyte	ERA Aquatic Life SV (ug/L)	Source	USEPA CCC (ug/L)	USEPA CMC GLWQCI (ug/L)	USEPA CCC GLWQCI (ug/L)	GLWQCI Notes
ALUMINUM	87	(g)				
ANTIMONY	ND					
ARSENIC	148	(h)	150	339.8	147.9	TR; AsIII
BARIUM	220	(a)				
BERYLLIUM	ND		NA			
BORON	750	(k)	NA			
CADMIUM	ND		0.33	2.067	1.4286	TR; H=50
CALCIUM	EN		NA			
CHROMIUM III	ND		103.87	1022	48.85	TR; H=50
CHROMIUM VI	ND		11	16.02	10.98	TR
COBALT	ND		NA			
COPPER	16.6/17.3	(g,j)	12.74	7.285	5.161	TR; H=50
IRON	1000	(g)	NA			
LEAD	1	(a)	3.93			
MAGNESIUM	EN		NA			
MANGANESE	120	(i)	NA			
MERCURY	NS		0.77	1.694	0.9081	TR; HgII
MOLYBDENUM	370	(i)	NA			
NICKEL	ND		73.70	261	29.02	TR; H=50
POTASSIUM	EN		NA			
SELENIUM	4.6	(h)	5	19.34	5	TR; Total Se
SILICA	NV		NA			
SILICON	NV		NA			
SODIUM	EN		NA			
STRONTIUM	1500	(i)	NA			
THALLIUM	10	(a)	NA			
URANIUM	2.6	(i)	NA			
VANADIUM	12	(a)	NA			
ZINC	221	(g,j)	167.51	66.6	66.6	

Notes from ERA
(a) USEPA Region 5 Ecological Screening Level (USEPA, 2003a).
(g) Total recoverable phase federal chronic freshwater AWQC (USEPA, 2009). If two values are presented, they represent dissolved and total recoverable phase AWQCs, respectively.
(h) Indiana Water Quality Standards applicable within Great Lakes System. Indiana Administrative Code, Title 327, Article 2 (IAC, 2006).
(i) Secondary chronic value (Suter and Tsao, 1996).
(j) Hardness dependent criteria adjusted to average hardness of Brown Ditch samples (206 mg/L as $CaCO_3$).
(k) USEPA Region 4 chronic surface water screening value (USEPA, 2001b). Recommended as boron screening level by USEPA Region 5.

From Comments:
Shaded Cells - Hardness specific criterion @ Hardness = 151 ppm; Comments indicate to use lower end of hardness data and not mean
USEPA: Current AWQC for the protection of freshwater aquatic life. http://water.epa.gov/scitech/swguidance/standards/current/index.cfm
USEPA GLWQI: Great Lakes Water Quality Initialtive Criteria Documents for the Protection of Aquatic Life in Ambient Water. EPA 820-B-95-004. March 1995